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the variation polygon indicates that the change is permanent, so far as ordinary racial characters have permanency.

But why, it may be asked, has selection not achieved *more* in this case? Why should the descendants of, say, a 25 per cent. beet not score better than this? There are probably several reasons why. (1) Physiological reasons probably offer obstacles. A beet can not be formed which is *all* sugar. There has to be present in the beet a machinery for *manufacturing* the sugar. Perhaps 25 per cent. is an impossibly high average for a race of beets. (2) Perhaps the exceptional 25-per-cent. beet owes its extra sweetness in part to environmental causes which are not permanent. In that case the extra sweetness is "somatic rather than germinal," as we should say in the case of an animal.

(3) Finally the discovery that beets are never self-fertilized, but in every generation are cross fertilized, explains why improvement of the beet through selection is so slow and tedious a process. What progress could the animal breeder expect to make if he were able to select only the dams, but never the sires, for his flocks? This is the condition which confronts the plant breeder in attempting to improve the sugar beet. The animal breeder is often chided with the small numbers which his experiments yield as compared with the enormous numbers which an experiment with plants may produce, but the animal breeder has at least this satisfaction that when the animals are securely penned there need be no uncertainty about pedigrees.

The careful observations of Shaw show that thrips, so common in the blossoms of plants and yet so minute as easily to escape notice and to penetrate within silk nets and under paper bags, may be a cause of unsuspected cross-pollination and unaccountable "mutation" in the breeding of cereals and other plants.

W. E. CASTLE

BUSSEY INSTITUTION,
October 24, 1914

## A NOTE ON MULTIPLE ALLELOMORPHS IN MICE

PROFESSOR T. H. MORGAN has recently published in this journal the results of some of his experiments on color inheritance in mice. In this paper he offers material which he considers "evidence establishing" a series of multiple allelomorphs. His series consist at present of four forms, "yellow, gray white-belly, gray

gray-belly and black.'' The essential point of his conclusion is that no more than two of these conditions can be transmitted by any one animal.

The fact that Cuénot in his series of classic papers on color inheritance in mice (1902–1911) recognizes these same four types as forming a group of allelomorphs is not mentioned by Morgan, whose paper, without knowledge of Cuénot's work, might well be taken to contain ''the evidence establishing this series of allelomorphs'' as he himself considers that it does. Since Morgan appears to have overlooked Cuénot's work with these forms, it may be interesting to give a brief statement of Cuénot's results.

As early as 1903 Cuénot recognized that albinos, potentially yellows, when crossed with black gave besides yellow offspring *either* black or agouti young, but not both. This is, of course, evidence that yellow, agouti and black are all allelomorphic to one another. In 1904 he gives formulæ (p. 46) showing that he considers this to be the case. At the same time he gives the ratios produced by crossing an albino potentially a *heterozygous gray* (agouti) with a yellow carrying black, but no agouti, and albinism. For present purposes the albinism in the cross is negligible. Cuénot recognized that the ratio expected from this cross was 2 yellow, 1 black and 1 agouti (gray). He obtained 34 yellow, 20 black and 16 agouti; the calculated numbers being 38 : 19 : 19. Sturtevant (1912) in discussing the allelomorphism or coupling of black, agouti and yellow in mice has also overlooked Cuénot's results, for in mentioning the cross of a heterozygous agouti with a yellow carrying black, he states ''apparently Morgan is the only one who has reported such a cross. He obtained 4 yellows, 5 agoutis and 1 black.''

To return to Cuénot's work; in 1907 he made a report on the hereditary behavior of the white bellied agouti variety (gris à ventre blanc) which he considers allelomorphic to yellow, agouti and black. On page 10 in speaking of *determinants* he says: ''Il y en a le même nombre dans les races unicolores et dans la race grise; ces races diffèrent, non pas par la quantité de leurs déterminants mais par la qualité.'' This is essentially the idea underlying multiple allelomorphism. Later in the same paper he says of G, the agouti determinant ''. . . il présent un grand nombre de mutations: G′, N et J.'' (G′ = white bellied gray; N = black and J = yellow.) On page 13 he tabulates the varieties, *in order of their dominance*, yellow, white-bellied agouti,

agouti and black. Morgan reached the same order of dominance in 1911 and has recently (1914) recorded them, beginning with black, as follows:

$b =$ black,
$B^G =$ gray gray-belly,
$B^w =$ gray white-belly,
$B^y =$ yellow.

In 1908 Morgan published certain facts concerning the inheritance of the white-bellied gray pattern. Cuénot at once (1908) publicly called Morgan's attention to the similarity of their material and added facts which showed that he had already investigated the inheritance of this same pattern in 1907. Morgan later acknowledged its similarity.

In 1911 Cuénot states plainly (p. 47): "Les souris jaunes sont characterisées par un déterminant J, allélomorphe a G, G′ et N, at qui les domine tous dans les croisements . . . il n'y à que les zygotes renfermant J dominant un autre déterminant allélomorphe (G, G′ ou N) qui peuvent évolouer."

Morgan's 1914 paper adds several detailed matings and records the testing of yellows of both sexes. However, in most respects, his work corroborates the pioneer experiments of Cuénot and does so in such detail that he falls into the same error as did Cuénot in considering "black" as a necessary member of the allelomorphic series. This is obviously incorrect for the whole series of allelomorphs exists equally well in forms *utterly lacking the ability to produce black pigment* as some of Morgan's experiments showed. The true series of allelomorphs is yellow, white bellied agouti, gray-bellied agouti and *non agouti* (not black).

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BUSSEY INSTITUTION,
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## LITERATURE CITED

Cuénot, L.
1902. La loi de Mendel et l'hérédité de la pigmentation chez les souris. *Arch. Zool. Exp. et Gén.* (3), Vol. 10, Notes et revue, p. xxvii.
1903. 2me note. *Arch. Zool. Exp. et Gén.* (4), Vol. 1, Notes et revue, p. xxxiii.
1904. 3me note. *Ibid.*, Notes et revue (4), Vol. 2, pp. xlx–lvi.
1905. 4me note. *Ibid.*, Notes et revue (4), Vol. 3, pp. cxxiii–cxxxii.
1907. 5me note. *Ibid.*, Notes et revue (4), Vol. 5, p. 1.
1908. 6me note. Sur quelque anomalies apparentes de proportions mendéliennes. *Ibid.* (4), Vol. 6, Notes et revue, pp. vii–xv.

1911. 7me note. Les déterminants de la couleur chez les souris, étude comparative. *Ibid.*, Notes et revue (4), Vol. 8, pp. xl–lvi.

Morgan, T. H.

1908. Some Experiments in Heredity in Mice. *Sci.*, N. S., Vol. 27, p. 493.

1911. The Influence of Heredity and of Environment in Determining the Coat Color in Mice. *Annals N. Y. Acad. of Sci.*, Vol. 21, pp. 87–117.

1914. Multiple Allelomorphs in Mice. AM. NAT., Vol. 48, pp. 449–458.

Sturtevant, A. H.

1912. Is There Association Between the Yellow and Agouti Factors in Mice? AM. NAT., Vol. 46, pp. 368–371.

## ON THE TIME OF SEGREGATION OF GENETIC FACTORS IN PLANTS

IN *Œnothera lamarckiana,* Geerts (3) has observed that two microspores of each tetrad abort. From the results of reciprocal crosses, De Vries (9) concluded that there was a segregation of genetic factors between the aborted and unaborted pollen-grains. In my crosses of *Stizolobium* species (2), half of the pollen-grains abort in a random manner in the anthers of the $F_1$ hybrids; and I can only explain the results of the breeding work on the hypothesis that there is a segregation between the four microspores of each tetrad. Hence I conclude that the segregation does not take place before the cell-divisions which form the pollen-mother-cells, but takes place in the divisions which form the microspores. In other words, segregation occurs here, not among the cells of the diploid generation, but at the moment of formation of the individuals of the haploid generation.

In the ovules of *Stizolobium* crosses I have shown that there is a random segregation of aborted and normal embryo-sacs; and this agrees with the observations of Geerts on the functional megaspores of *O. lamarckiana.* If somatic segregation occurred, there would be a segregation of whole ovaries or parts of ovaries with ovules all aborted or all normal, causing a distribution which would differ markedly from the binomial distribution demanded by a random segregation according to the law of chance. I have shown that with lots of $n$ ovules each, the distribution of the aborted and normal ovules corresponds to the binomial $(1+1)^n$. Hence segregation can not have taken place before the formation of the nucellus of the ovule.

In many species and varieties of *Citrus,* as Strasburger (7)